Population Health Monitoring System Evaluation for BioNet

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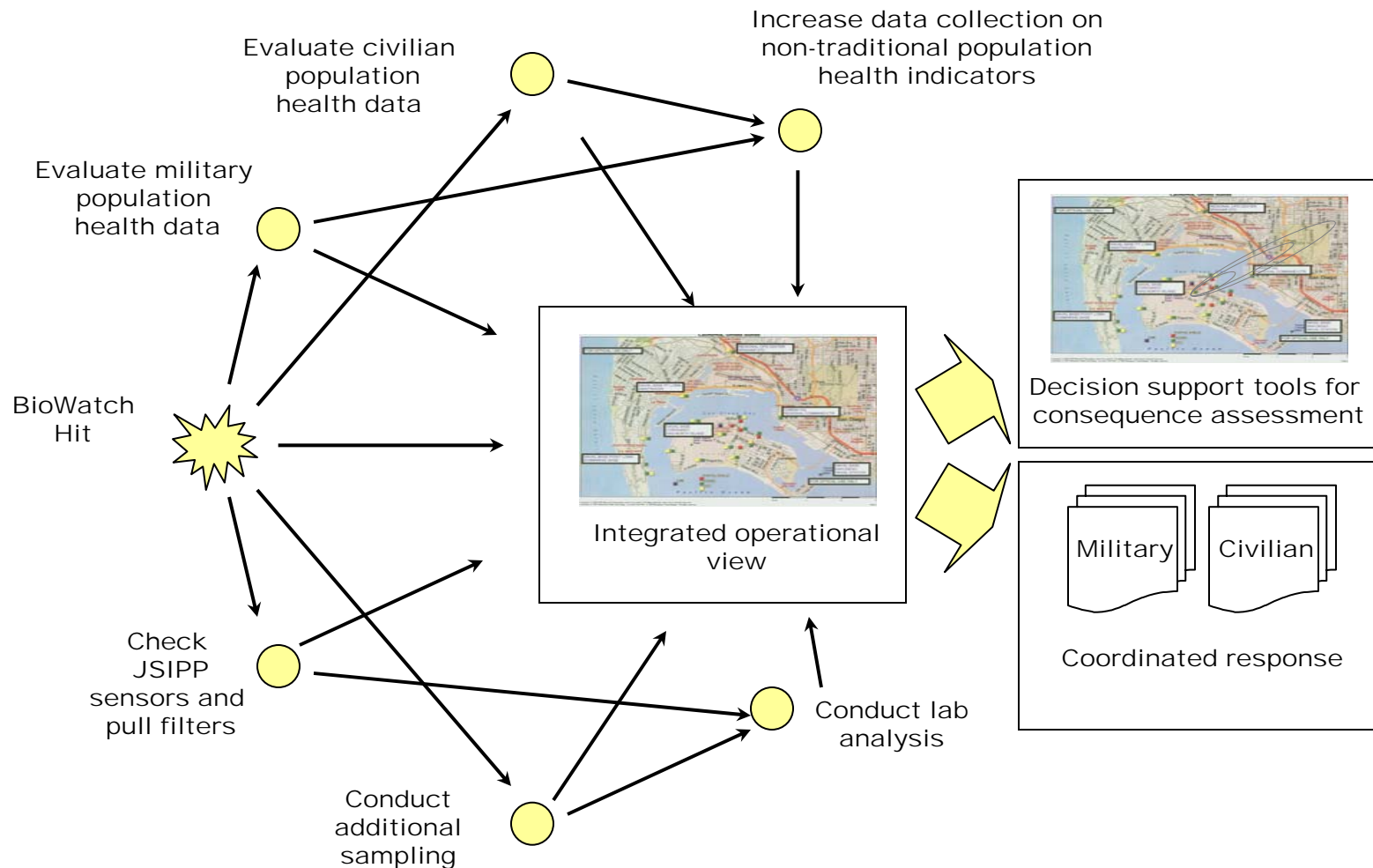
BioNet – Focused on Consequence Management

Vision

Effectively manage the consequences of a biological attack

Objectives

- Develop interoperable military and civilian concepts of operation

- Integrate military and civilian capabilities to detect and characterize a biological event

- Provide common situational awareness to ensure timely, effective, and consistent response actions

BioNet Will Integrate
These Distinct Capabilities

Evaluate civilian
population
health data

Increase data collection on
non-traditional population
health indicators

Evaluate military
population
health data

BioWatch
Hit

Integrated operational
view

Decision support tools for
consequence assessment

Check
JSIPP
sensors and
pull filters

Conduct lab
analysis

Military   Civilian

Coordinated response

Conduct
additional
sampling

Health Monitoring Objectives

- Test and evaluate approaches for "all source" analysis of military and civilian health monitoring data
- Evaluate Concepts of Operation (ConOps) for applying health data to consequence management activities
  - Civilian and military ConOps
  - Characterization of biological sensor data and JSIPP events
- Analyze effectiveness of health monitoring components within overall BioNet system

Health Monitoring Task Elements

1. Implement civilian health surveillance server at San Diego County Public Health Department using COTS/GOTS

    –   Hospital reporting

    –   Existing automated sources

    –   Data management capability

    –   Patient data de-identification/re-identification capability

2. Establish de-identified data feeds to BioNet integration/visualization capability

Health Monitoring Task Elements

3. Test and evaluate anomaly detection and characterization using combined military and civilian data

   – Characterize San Diego background

   – Address data quality and confounders

4. Develop and test concepts of operation for use of health monitoring in the context of the BioNet system

   – Scenarios based on biological sensors/JSIPP and "astute clinician" events

5. Establish performance measures and evaluate health monitoring component performance

Syndromic Surveillance

- ## Definition
  - Monitor disease indicators using automated data acquisition and statistical alarms on a continual basis to detect outbreaks of disease earlier and more completely than would otherwise be possible with traditional public health methods
  - Usually apply automated analysis and visualization tools
  - Data types are what differs from traditional disease surveillance
    - Use data that reflect events that precede clinical diagnoses

- ## Purpose
  - Outbreak detection and management
  - Disease case detection and management

Evaluation

- ## System description
  - Purpose – what is it designed to accomplish?
  - Stakeholders – who is it serving?
  - Operation – how does it work?

- ## Outbreak detection
  - Timeliness
  - Validity – how does it distinguish between outbreaks of public health significance and normal variance?

- ## Experience
  - Usefulness
  - Flexibility
  - Acceptability
  - Portability
  - Stability
  - Costs

System Description

- ## Purpose
  - The system is designed to provide long-term, improved biological event characterization through integration of military and civilian population health

- ## Stakeholders
  - San Diego County Health and Human Services Agency
  - Navy Environmental and Preventive Medicine Unit #5
  - Navy Region Southwest
  - Data providers

- ## Operation
  - A civilian population health surveillance node will be established
    - Integrated Data Repository and Analysis Engine (IDRAE)
  - Military node
    - ESSENCE IV
  - Integration node using de-identified data
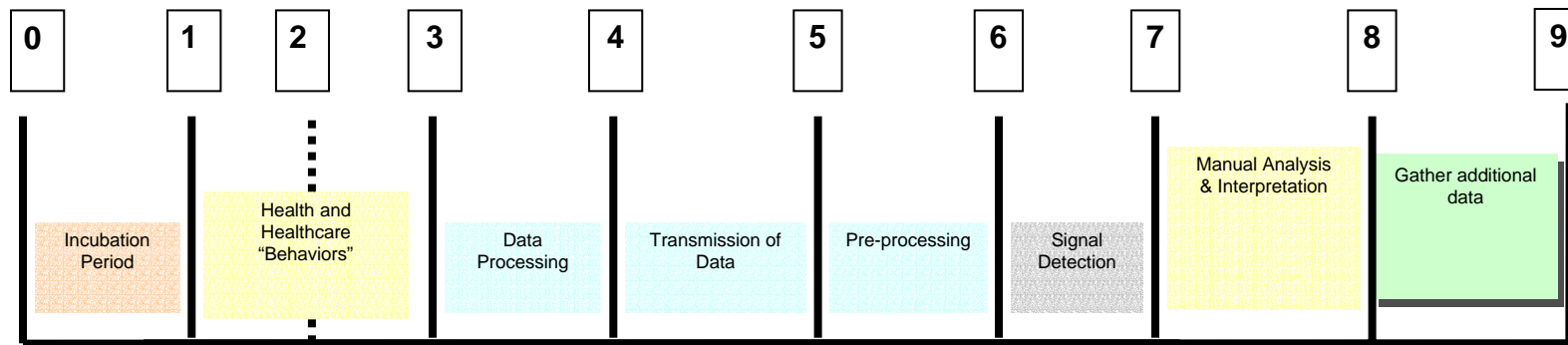   - Composite GIS view

Data Types

- Existing data at San Diego county HHSA
  - Quality Assurance Network (daily)
    - Paramedic transports
    - Chief complaints
    - ER diversions
  - School absenteeism (Project SHARE) (daily)
    - Health office visits
  - OTC data (RODS) (daily)
  - Influenza-like Illness rates at sentinel hospitals
  - Communicable disease reports (as needed)
- Hospital emergency department data
  - Chief complaint data
  - Emergency departments in San Diego (subset)
- Military outpatient ICD9 codes, procedure codes, pharmacy transactions and possibly lab test orders

Outbreak Detection

- Timeliness
  - Monitor timeliness for both data capture and processing, and time to alert
  - Determine
    - Length of time from potential exposure (based on incubation period, etc.) to capture and alert
    - Length of time from behavior (purchase OTC, visit physician) to capture and alert
  - Did it result in interventions implemented more quickly?

0	1	2	3	4	5	6	7	8	9

Incubation Period

Health and Healthcare "Behaviors"

Data Processing

Transmission of Data

Pre-processing

Signal Detection

Manual Analysis & Interpretation

Gather additional data

Outbreak Detection

- Validity
  - Need to determine validity of each data source
  - Need to establish definitions for an outbreak
  - Compare data sources using the same case definitions, statistical analyses and account for reporting delays (both retrospective and prospective)
    - All data sources will not detect all types of outbreaks
    - Need to characterize these differences
  - Use both naturally occurring and simulated outbreaks

Validity

- ## Sensitivity
  - Percentage of outbreaks occurring that are detected
    - Positive predictive value is the probability that a system alarm is an outbreak
    - Negative predictive value is probably that no outbreak occurs when no alarm
  - Need gold standard data to confirm missed outbreaks
  - PPV will be very low for bioterrorism events
  - Improving sensitivity by lowering threshold will decrease PPV even more
    - Need to improve sensitivity through more/better data or better algorithms
  - Need to calibrate sensitivity and PPV with local needs
  - Evaluate sensitivity in multivariate mode using different combinations of data sources and algorithms

Validity

- Data quality
  - Difficult to find gold standard
  - Military data has current records review underway
  - May be able to use more specific data to verify quality of other data sources in the same population
    - Comparison of syndromic data to ILI rates, CDC ILI surveillance and influenza specimens
  - For each data source determine
    - Representativeness
    - Completeness

System Experience

- ## Usefulness
  - Inexact measurement
  - Questionnaire to stakeholders asking
    - Did it meet objectives?
    - What disease prevention and control actions were (or weren't) taken as a result of using the system?
    - What outbreaks were detected?
    - Did it detect or track other health problems?
    - Did it provide reassurance?
    - What aspects were most/least useful?

System Experience

- Flexibility
  - – Was the system adaptable to changing needs?
  - – Could it easily input new data sources and algorithms?
  - – Could sensitivity and case definitions be altered as needed?

System Experience

- Acceptability
  - Are the data providers willing to contribute?
    - Any difficulty with HIPPA regulations?
  - How much was it actually used?
    - Can use automated statistics from web-based programs

System Experience

- Portability
  - Can it be easily duplicated in another setting?
    - Adherence to PHIN standards to reduce variability in IT application
  - What segments are difficult to transfer?
    - Data sources
    - Analysis program

System Experience

- Stability
  - How much downtime due to
    - Data not sent?
    - System outages or service periods?
    - Personnel shortages?

System Experience

- Costs
  - Document costs for
    - Data transfer
    - System setup
    - System maintenance
    - Equipment
  - Determine one time vs. ongoing costs
  - Determine personnel/resources costs
    - How many investigations initiated at what cost?
    - Any benefit obtained?
  - Resource/personnel costs difficult to calculate

Population Health Scenarios

- Develop scenarios for population health data based on detection of pathogens by biological sensors

- Identify population health indicators that could contribute to event characterization

- Conduct two tabletop exercises to evaluate the BioNet system

Evaluation Summary

- ## Data sources
  - – Description of representativeness and completeness
  - – Sensitivity calculations based on comparative analysis and comparison to gold standard if available
  - – Multivariate analysis of all data sources in combination
  - – Sensitivity analysis of algorithms
- ## Goal – determine most sensitive combination of data sources and algorithms

Evaluation Summary

- Timeliness
  - Determine timeliness of each data source and where improvements could be made
  - Determine if time lag can be compensated
- System experience
  - Description of various elements, including questionnaire to stakeholders
- Tabletop exercises
  - Answer experience questions and assist with improving system elements

Summary

- ## Data standards
  - – Integrated system will conform to PHIN standards
  - – Evaluation will include
    - How standards can improve automated exchange of data between public health partners
    - Any difficulty in obtaining data sources that conform to standards